

Report On

# 3-D SCANNER

Presented by

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# Declaration

We hereby declare that this report titled 3-D Scanner is presented as a report for one day training in ELL in Indian Institute of Technology, Bombay, except to the extent that assistance from other sources are duly acknowledged. All sources used for this course report have been fully and properly cited. It contains no material which to a substantial extent has been submitted for the award of any degree/diploma in any institute or has been published in any form, except where due acknowledgement is made.

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# Introduction

3D scanning is a process of creating a digital model or representation of an object. The exact shape and size of the object can be captured and the created 3D model can be further used in CAD. The 3D scanner can output a meshed file for 3D printing for both non watertight and watertight models.

## Design & Specification

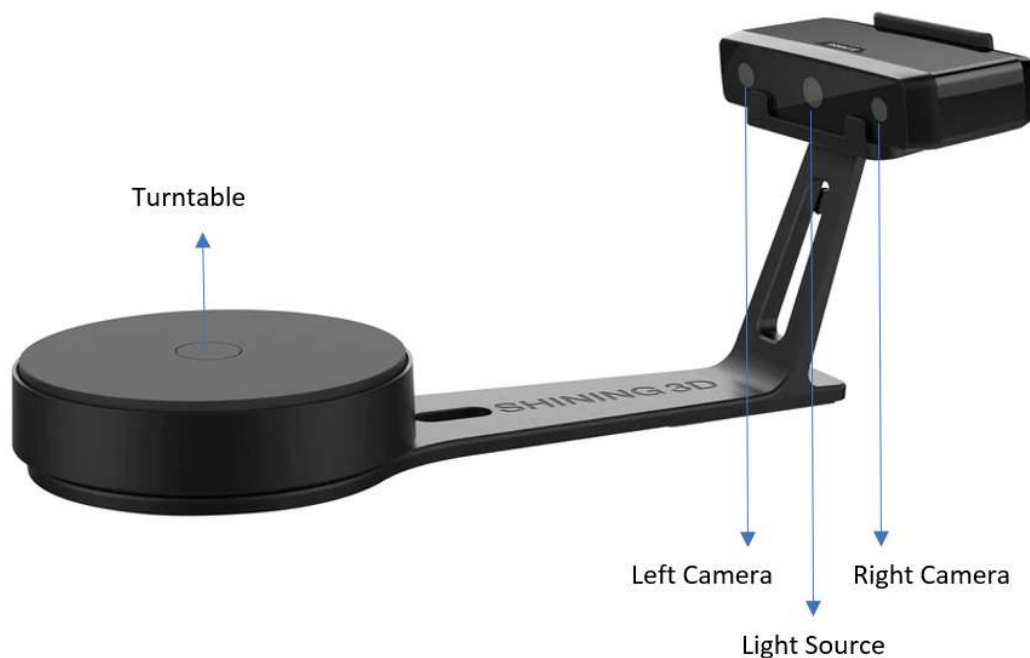


Figure 1 3D scanner

## Design Details

- **Turntable**

A flat surface for placing the object. This surface rotates for the camera to be able to perform the scan.

- **Right and Left cameras**

2 cameras to replicate stereo vision.

- **Light Source**

A light source of RGB as well as white light for illuminating the object to be scanned.

## Specifications

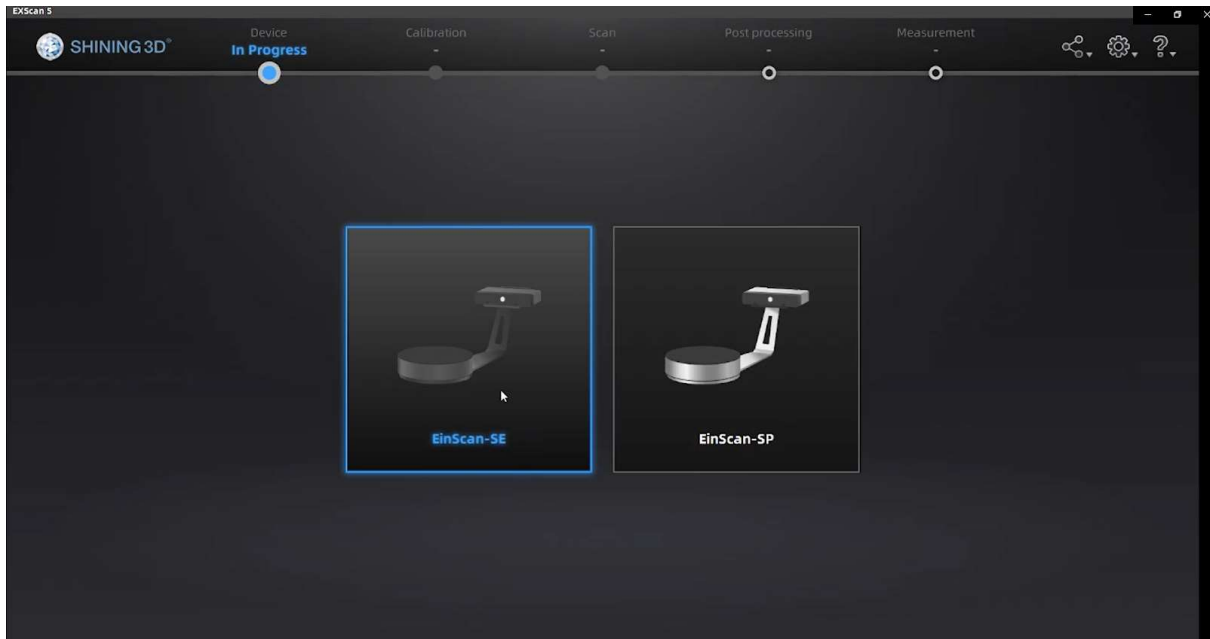
<b>Machine Name</b>	3D Scanner	
<b>Model</b>	EinScan SE	
<b>Make</b>	Shining 3D	
<b>Scan Mode</b>	Fixed Scan with Turntable, Fixed Scan without Turntable	
<b>Mode of Alignment</b>	Feature; Manual; Turntable	Feature; Manual
<b>Single Shot Accuracy</b>	$\leq 0.1$ mm	
<b>Minimum Scan Volume</b>	30 × 30 × 30 mm	
<b>Maximum Scan Volume</b>	200×200×200 mm	700×700×700 mm
<b>Single Scan Range</b>	200×150 mm	
<b>Scan Speed</b>	Single Scan < 8 s	

<b>Point Distance</b>	<b>0.17 mm ~ 0.2 mm</b>
<b>Texture</b>	<b>Yes</b>
<b>File Format</b>	<b>OBJ, STL, ASC, PLY</b>
<b>Camera Resolution</b>	<b>1.3 Mega Pixels</b>
<b>Light Source</b>	<b>White Light</b>
<b>Working Distance</b>	<b>290 ~ 480 mm</b>
<b>Computer Requirements (Required)</b>	<b>USB:1 ×USB 2.0 or 3.0; OS: Win10 (64 bit); CPU: Dual-core i5 ; RAM: 8G</b>
<b>Computer Requirements (Recommended)</b>	<b>Graphics card: Nvidia series;Graphics memory &gt; 1G</b>
<b>Net Weight</b>	<b>2.5 kg</b>
<b>Dimension</b>	<b>570×210×210 mm</b>
<b>Power Supply</b>	<b>40 W</b>
<b>Input Voltage</b>	<b>DC: 12 V, 3.33 A</b>
<b>Calibration Board</b>	<b>Standard</b>
<b>Turntable</b>	<b>Standard</b>
<b>Load Capacity of Turntable</b>	<b>5 kg</b>

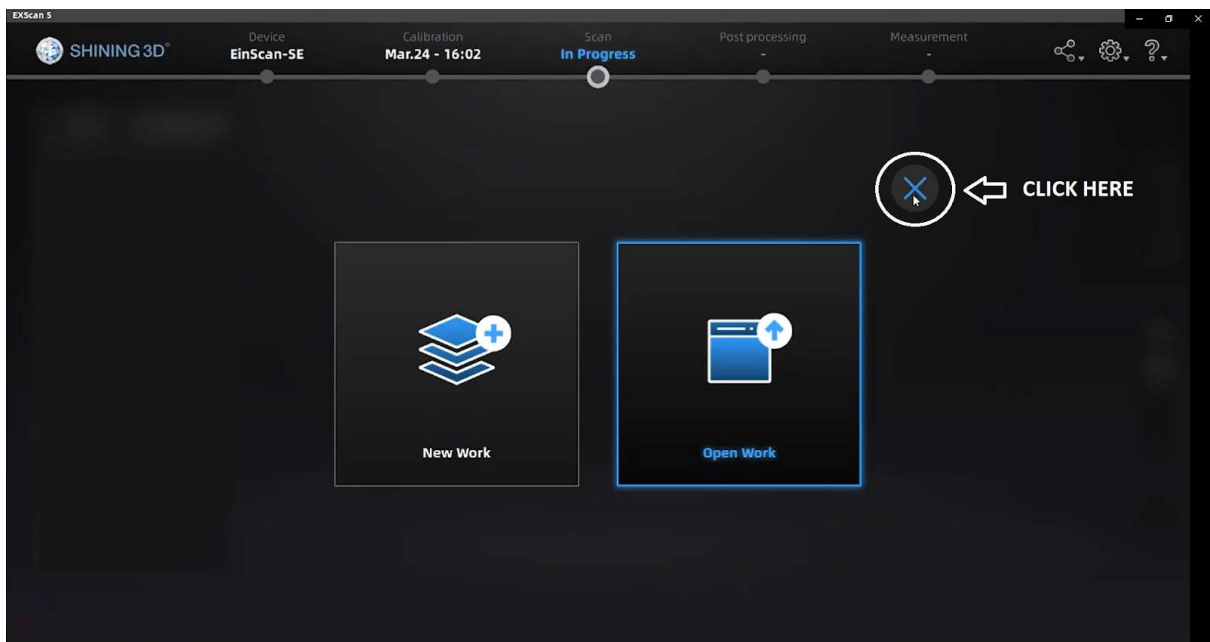
# Operating Procedure

## Calibration

1. Turn on the device using the Power button present at the back of the scanner. Open the EXScan S software. Select your 3D Scanner Device.

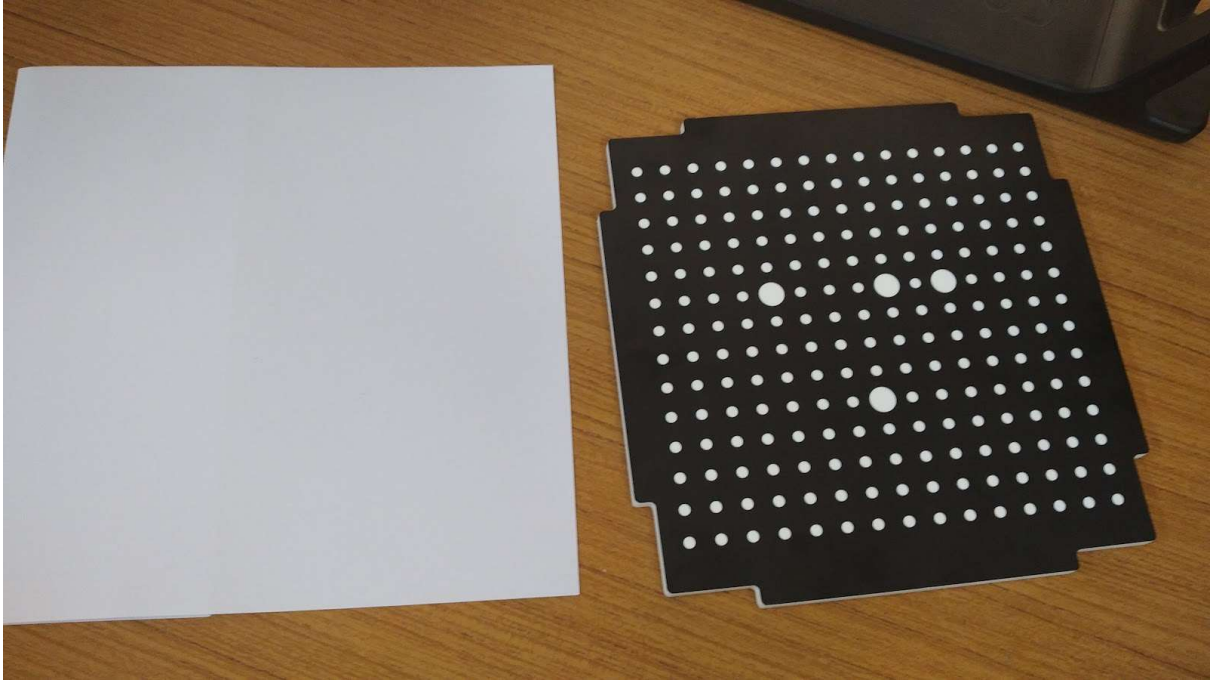


2. Enter Calibration Mode



In order to enter the calibration mode we do not select either the new work or open work option, after clicking on the highlighted cross shown, you will enter the calibration mode.

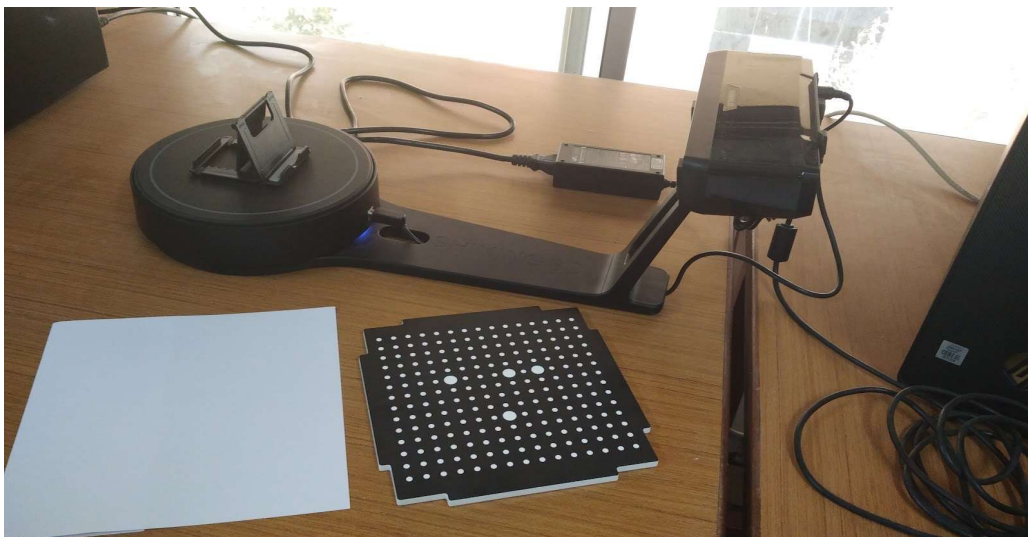
3. Equipment needed for calibration - White Paper, Dot Matrix Board and Stand. The size of the white paper should be enough to cover the camera view area. Generally an A4 size sheet is good enough.

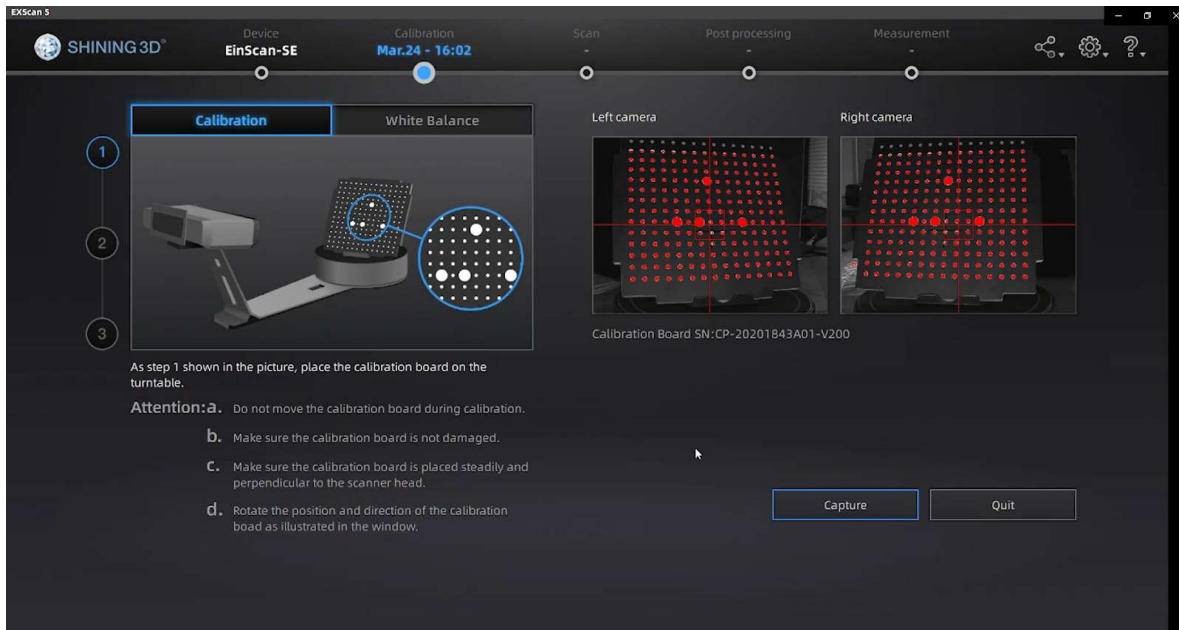


Setup :-

The Dot Matrix board is provided in the kit. Place the board according to the different orientations shown to you on the computer screen as per the instructions given by the software.

4. Place the Dot matrix board on the stand according to the photo shown. The board should cover the view of the left and right camera.





We can see that the board is placed according to the instructions given above

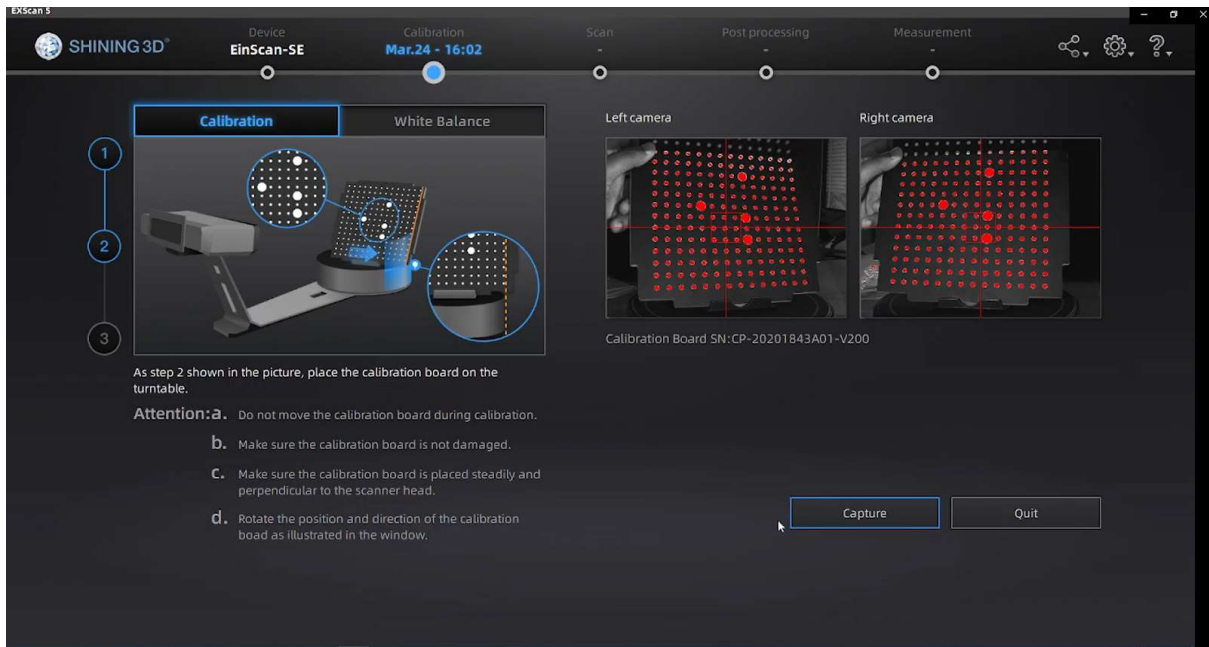


We have to do this step three times as highlighted by the sequence numbers in the first image of this step. Since this is the first step in the series of steps we see 1 getting highlighted in the top left corner of image 1 in this step. In further steps, the orientation needs to be changed by rotating the board by 90 degrees and placing it on the stand.

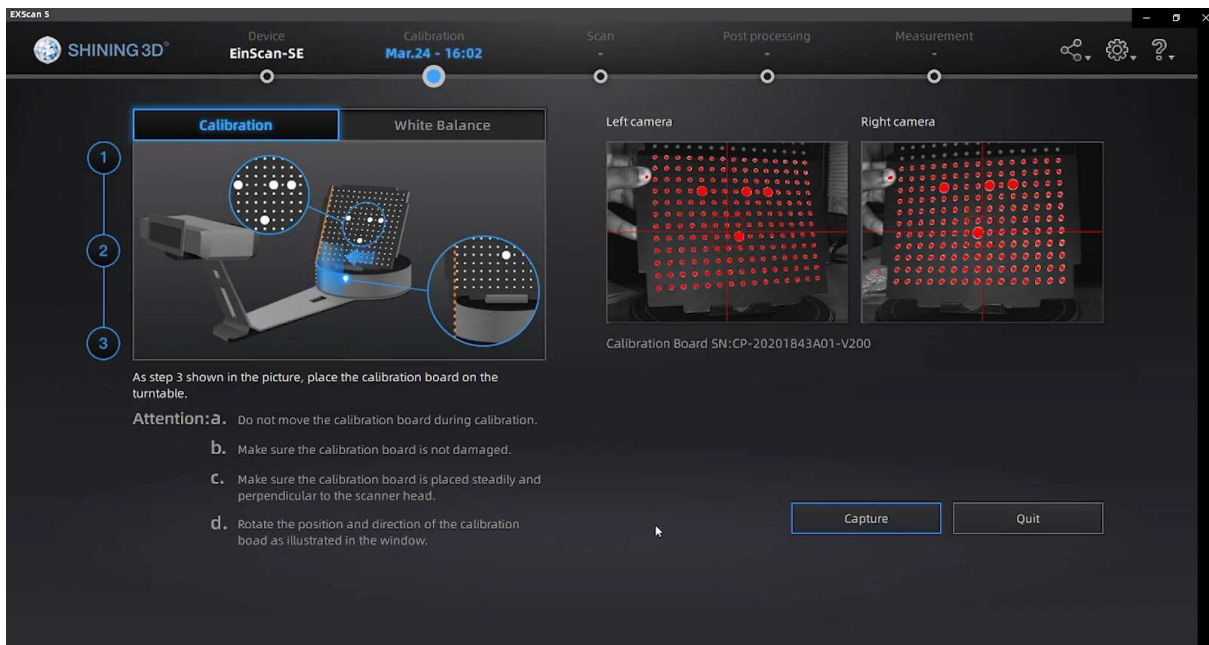


## 5. Repeat for different Dot matrix orientation

Orientation 2 - Here the board is rotated counterclockwise by 90 degrees. The orientation to be done will be mentioned on the software window on the left side of the camera frames.

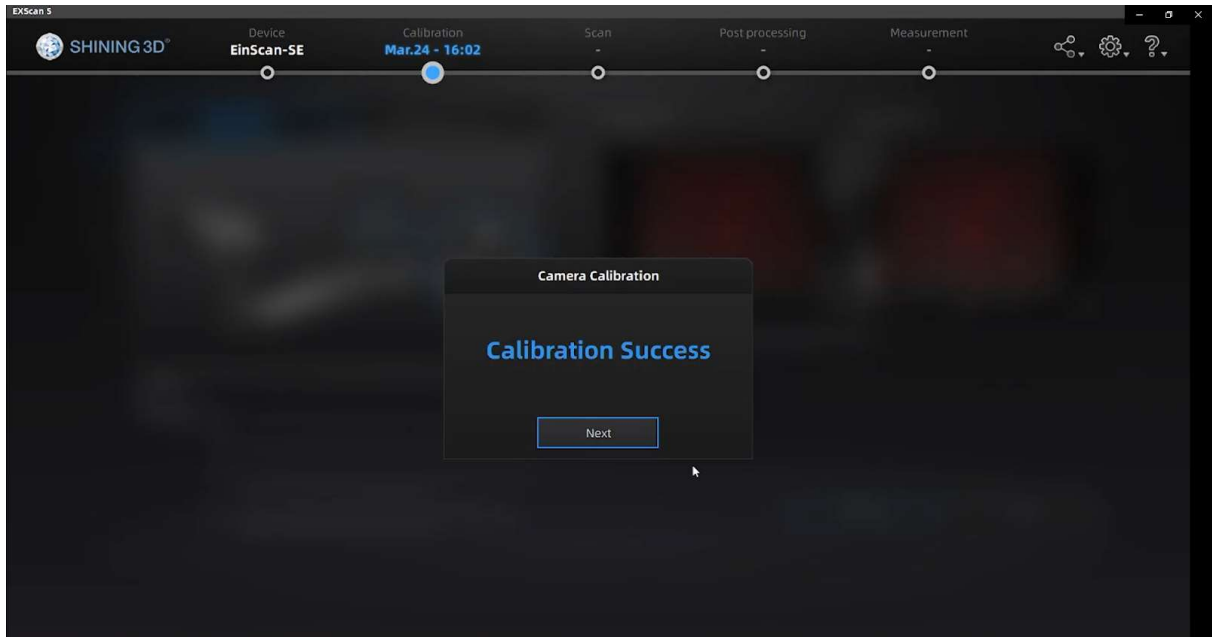


## Orientation 3

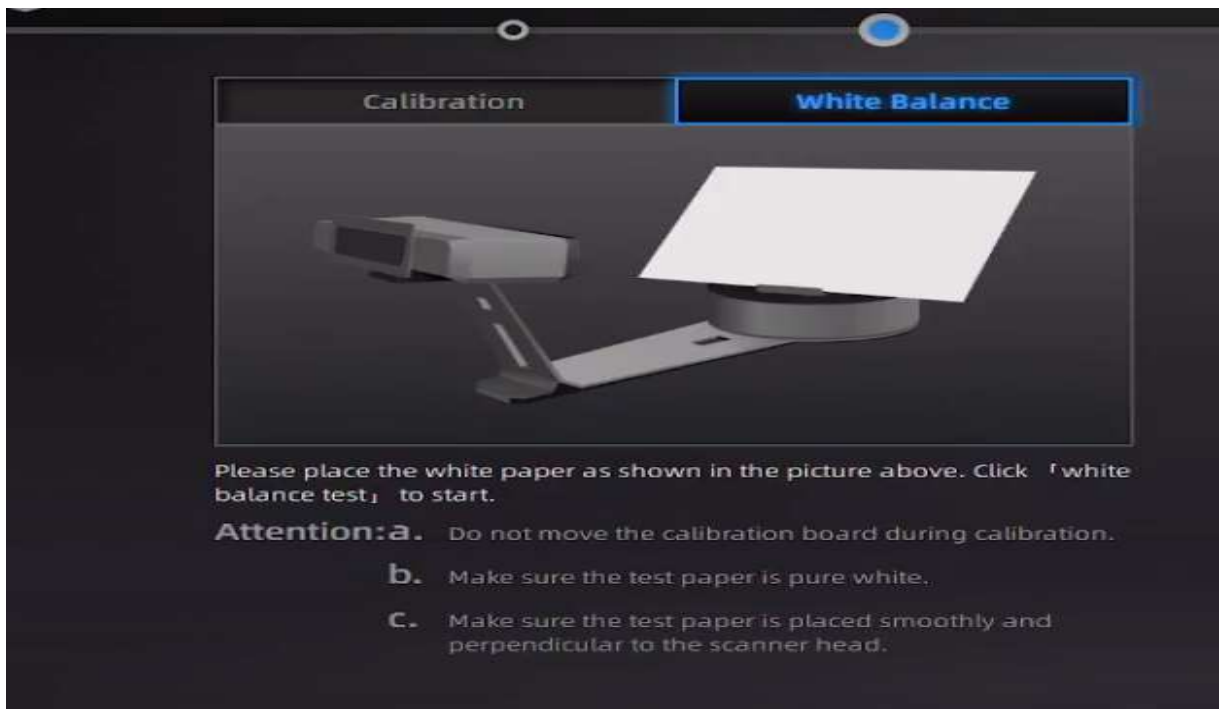


After placing the dot matrix board according to 3 different orientations as given by the software, it calculates the camera calibration matrix and displays calibration success message and then proceeds to white balance settings.

## 6. Calibration Success and White balance



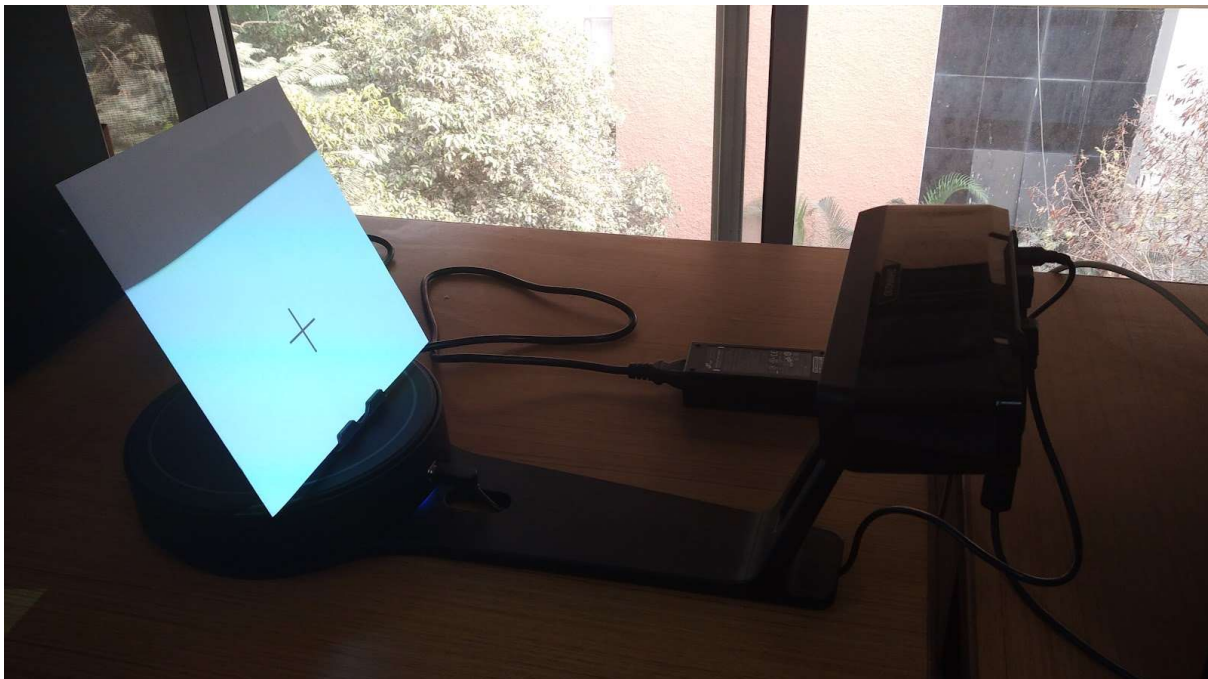
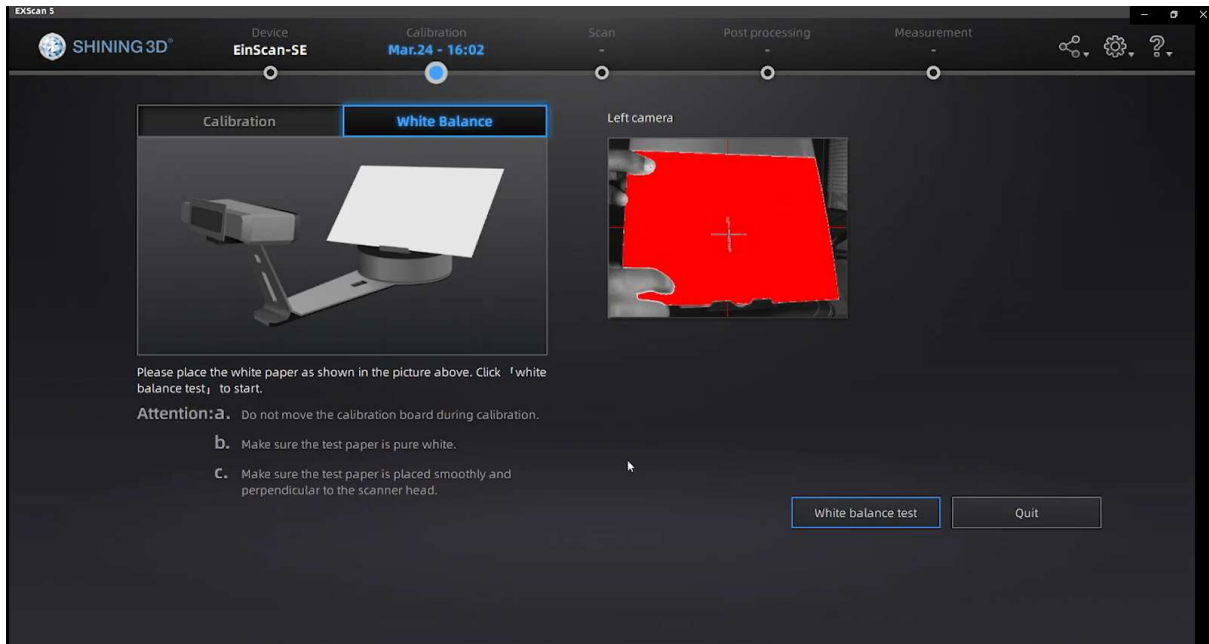
Some Instructions for white balance calibration are shown below.



The software automatically moves to white balance settings once camera calibration is done, if you only want to adjust white balance then you can click the white balance option and proceed with the following steps.

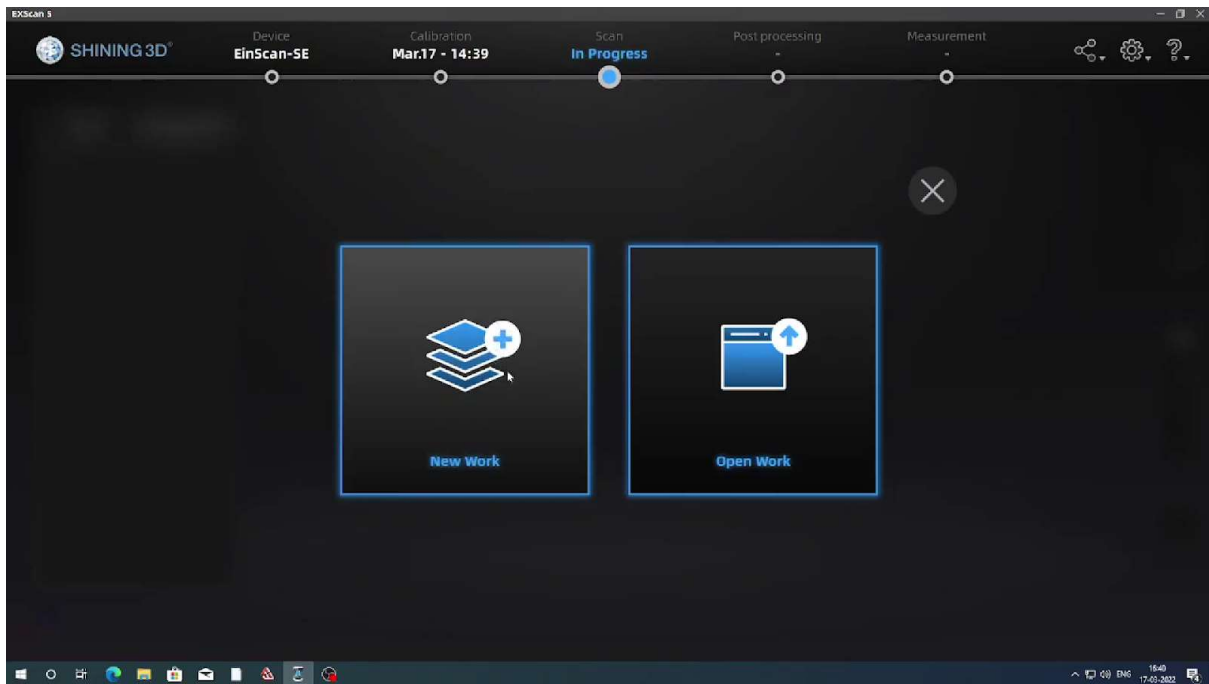
## 7. White balance

Place the white paper on the stand and it gets highlighted as red as shown. The white paper should be straight so use a hard paper or stick the paper temporarily on a hard cardboard. Then click on White balance test button at the bottom of the camera frame at the right side on the software window.

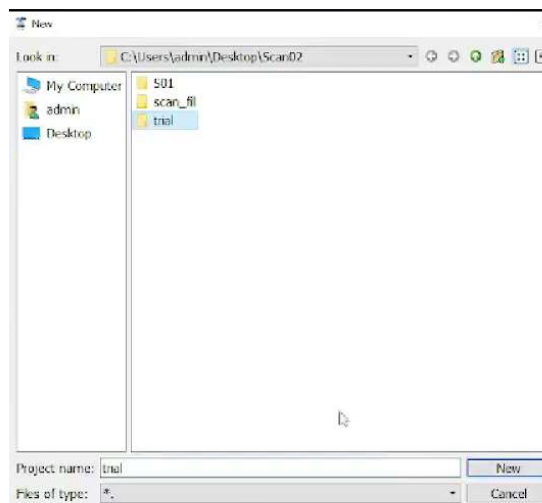


# Scanning

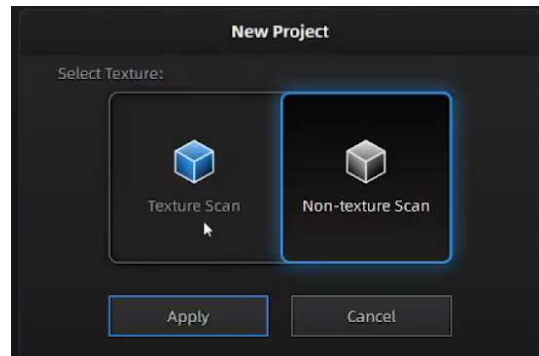
1. To begin scanning, select **New Work**.



2. Save the project in the destination folder.



3. Select between **Texture Scan** and **Non-Texture Scan** as per your needs. If the object is smooth like the one that has been shown in this manual or when colours and textures on the object need not be taken into account, **Non-texture Scan** is preferred.



4. Place the object of interest on the centre of the turntable.



5. Adjust the brightness of the white light such that no part of the object appears red in the rendered image.

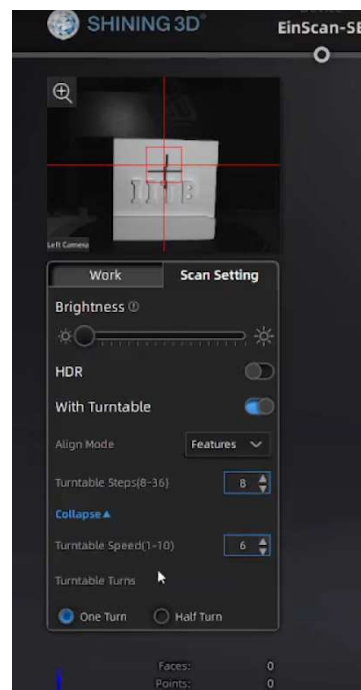
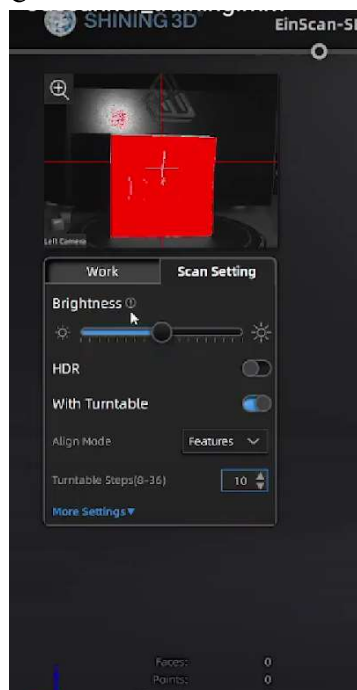
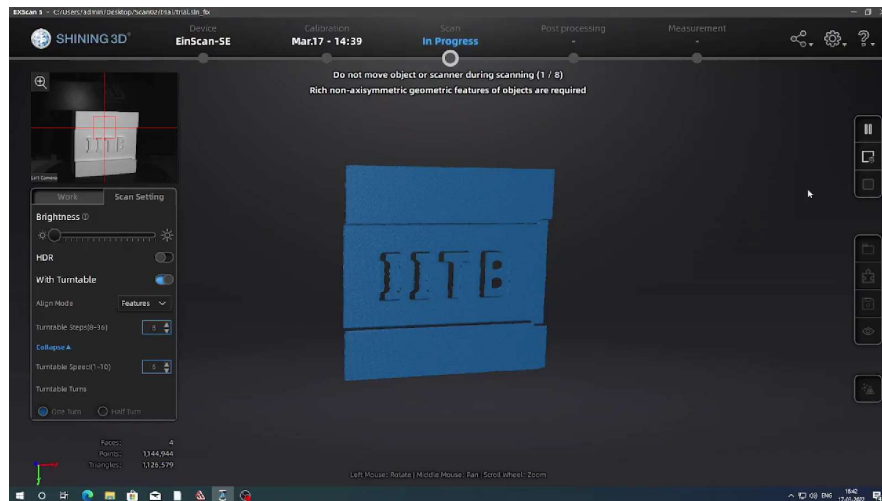


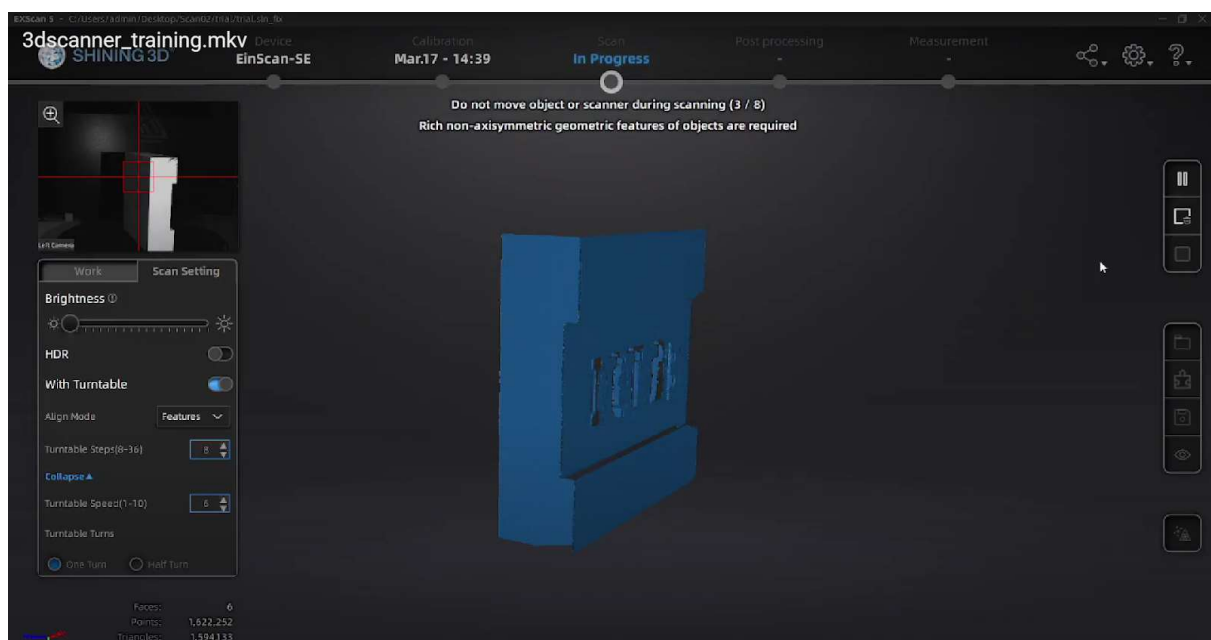


Figure (i) shows Incorrect brightness adjustment. No part of the rendered image must look red as shown in figure (ii). The object is clearly and visibly illuminated and shows the embossing clearly. This is optimum brightness adjustment.

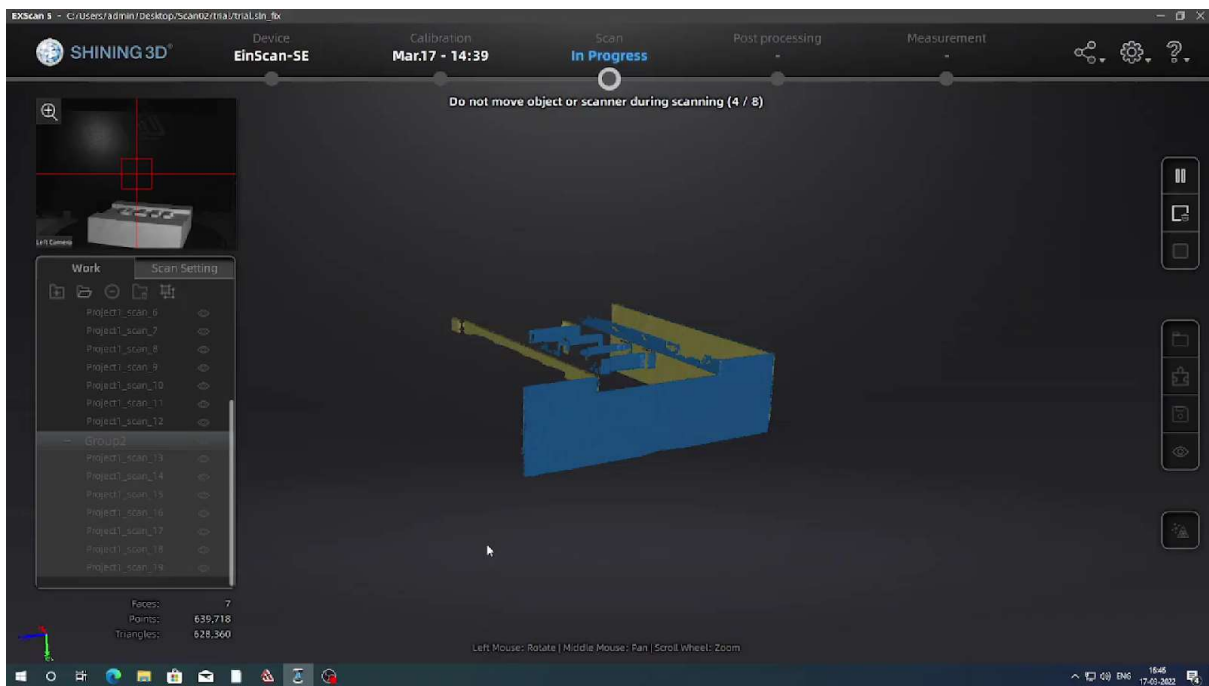
- Now click on the triangle Play button at the top of the vertical bar on the right side of the software window. The 3D scanner has now started scanning. As the scan progresses, the turntable rotates and partial scan results start showing up.



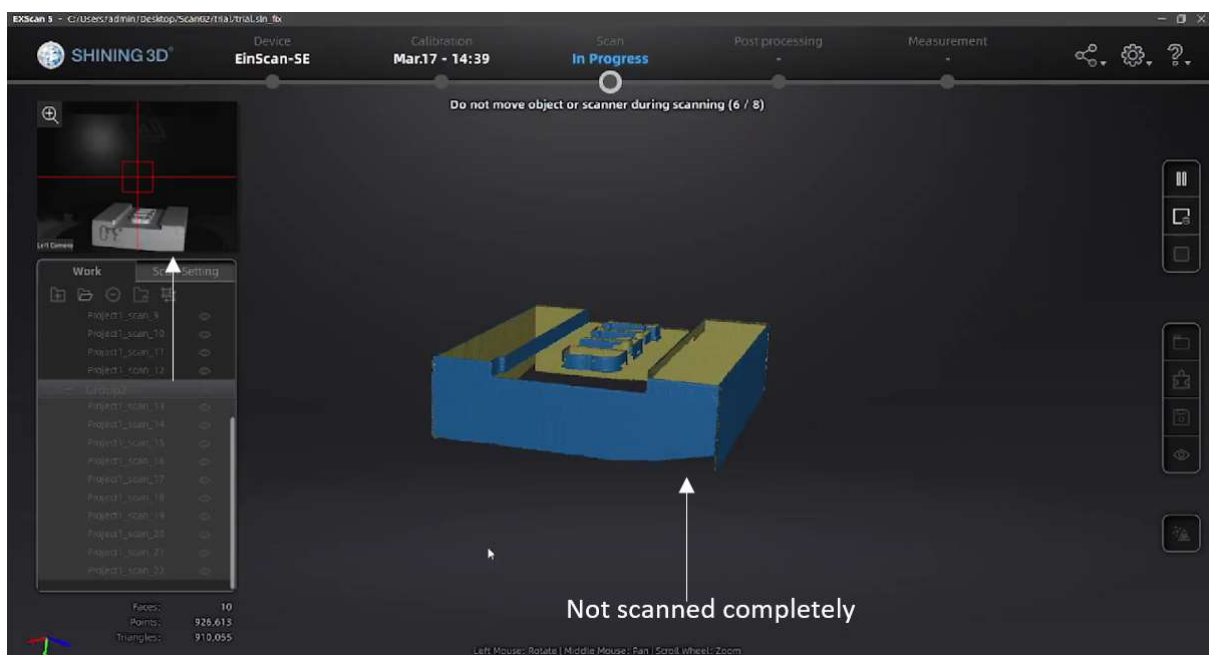
- The completed rotations of the turntable are visible at the top. DO NOT move the object while scanning as it leads to distorted model formation.



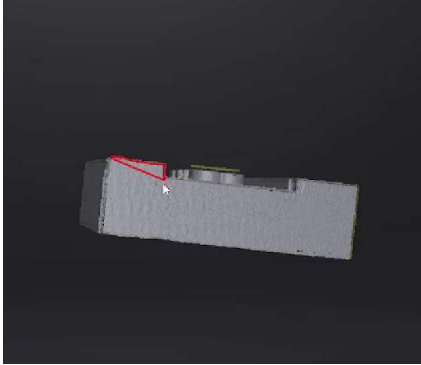
8. More than one scan in different orientations can be taken in case certain parts of the objects are not visible. Place the object in the required position and follow steps 4 - 7.



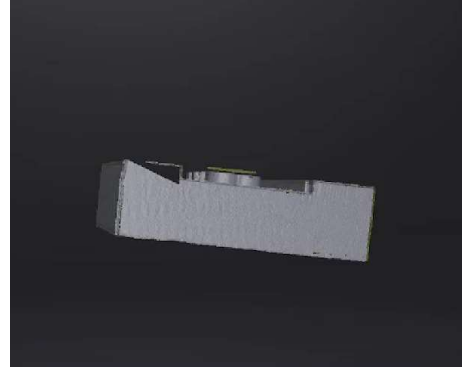
9. Make sure that the complete object is covered inside the camera frame. As can be seen here, the bottom right corner of the block is slightly cut-off in the camera frame and the same is visible in the model.



10. Any part of the model can be removed by selecting it and clicking on the **Delete part** option available on the right. For this, the **Shift** key and the left button of the mouse must be pressed on simultaneously as you drag the cursor.



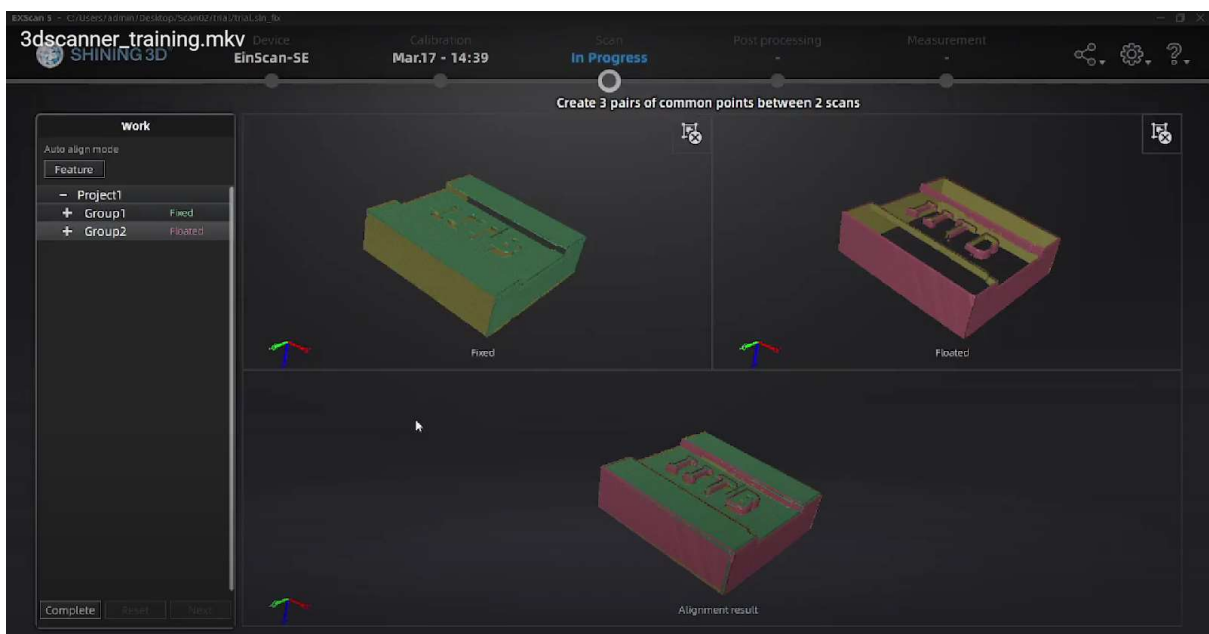
(i)



(ii)

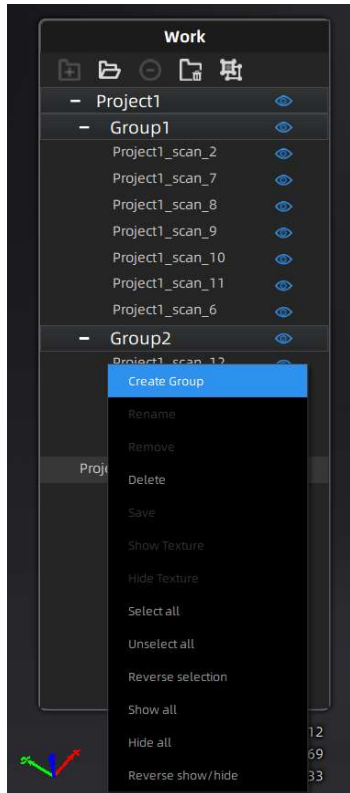
Image (i) shows the model with the selected part. Image (ii) shows the resulting model with the removed part.

11. Now, the application uses all the scans to create the final model. In this instance, 2 scans have been used. This can be done either **automatically** or **manually**. Every subsequent scan is by default automatically combined with the earlier scan based on optimisation done by the software itself. For the manual option, please see the next steps.



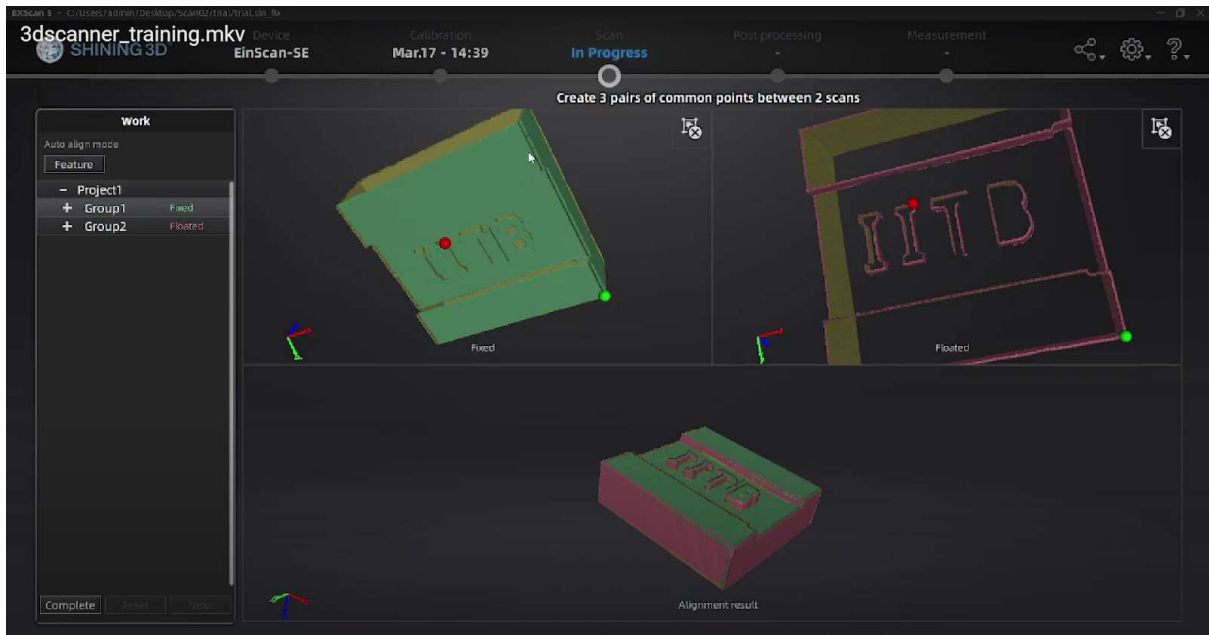
12. For manually combining the two scans, right click the scan name and select Create Group. Scan from two groups can be combined. Likewise, create a group for the second scan.



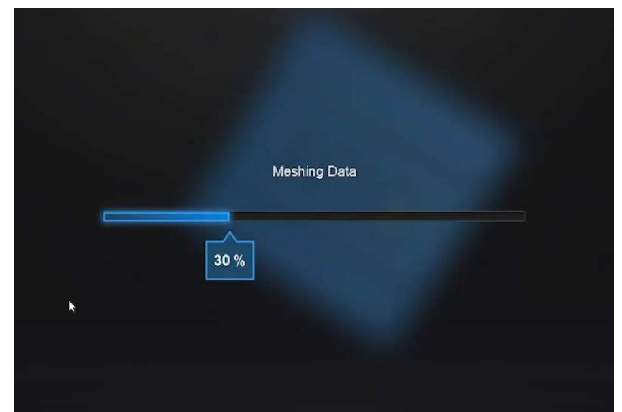
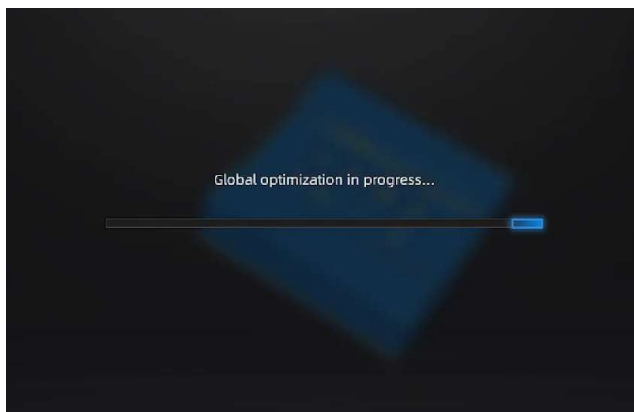


13. Now click on the Align button found on the vertical bar at the right side of the screen. Drag the two groups to the two windows where 'drag and drop the data here' is mentioned. Here **three sets of points** in each of the scans need to be selected. The image below shows two such pairs of points. For selecting a point, hover the mouse at the point of interest and select it by pressing the Shift key and the Left Button of the mouse.

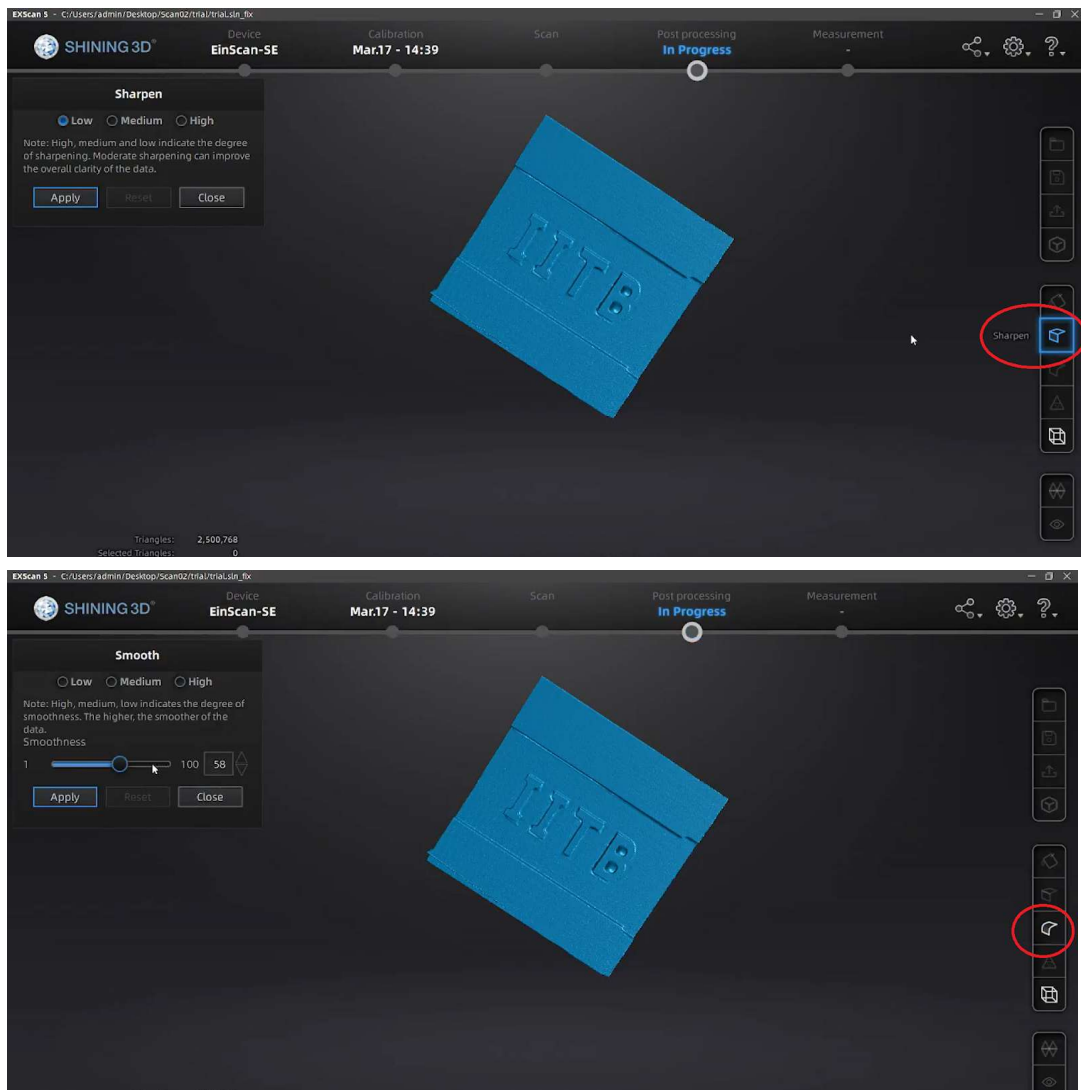




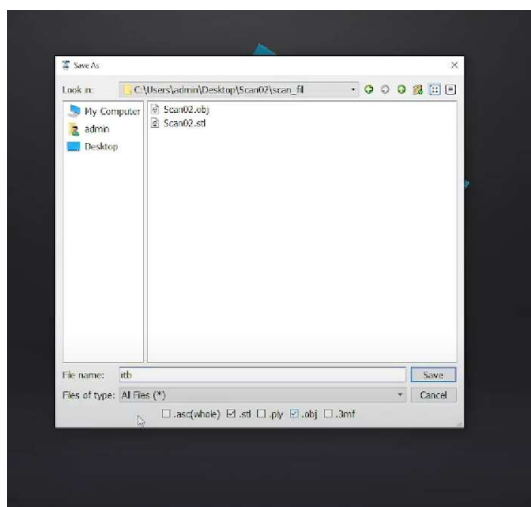
14. Once the points are selected, the optimisation is done automatically. Now click on **Complete** which brings us back to the main screen. Click **Global Optimization** for completing the process of combining scans. Then select **Mesh data** to create a 3D printable output. These buttons are available at the vertical bar on the right side of the model viewing area.



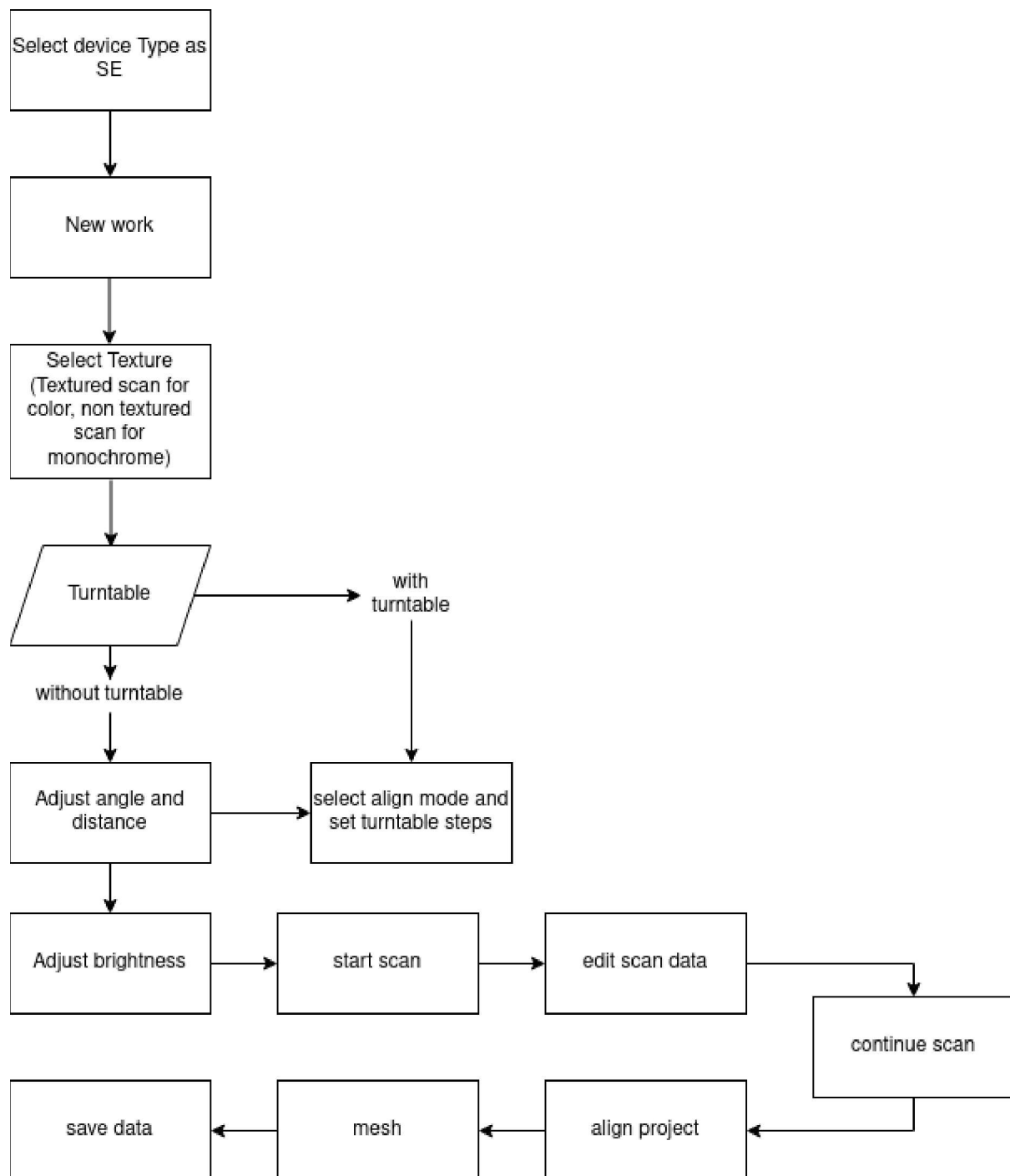
15. The scanning software provides features for sharpening and smoothening the obtained scan. Select the level of sharpen and smoothen as desirable using the corresponding buttons in the menu on the right.



16. Save the final scan in the destination folder. The application then displays the dimensions of the final model. The model can be scaled up or down as per the user's requirements.



# Quick Operation Guide



# DO'S and DON'TS

- Extra light sources should not be there to disturb the light from the camera source, as this would result in poor scan.
- Size of the object should be greater than 30mm x 30mm x 30mm.
- Transparent objects like objects made of glass, or shiny objects like steel objects, and black objects like computer mouse cannot be scanned. Solution is to paint the object with any primary colour or to cover it in paper colour.
- Keep the brightness level where the object is properly visible any red spots on the object means over illumination, adjust brightness level to avoid red spots.
- If you want high detailing then increase the steps in which the turntable rotates, more steps result in detailed object capture.
- Camera calibration should be done when the lighting conditions change or the setup is moved.

# Useful Links

**1. Product link -**

[https://www.einscan.com/desktop-3d-scanners/einscan-se/?gclid=CjwKCAjwiuuRBhByEiwAFXKaNK\\_UFEkouT-op3YohwojrpuqduTK0l4W-p79M7BK0gKwOq4okKU6RoCfvAQAvD\\_BwE](https://www.einscan.com/desktop-3d-scanners/einscan-se/?gclid=CjwKCAjwiuuRBhByEiwAFXKaNK_UFEkouT-op3YohwojrpuqduTK0l4W-p79M7BK0gKwOq4okKU6RoCfvAQAvD_BwE)

**2. Operation video demo -**

[https://drive.google.com/file/d/1ZgMezE5uGbA4Hr6PPftB\\_3-kdcSIY08P/view](https://drive.google.com/file/d/1ZgMezE5uGbA4Hr6PPftB_3-kdcSIY08P/view)

**3. EinScan SE operating guidebook**

<https://www.einscan.com/wp-content/uploads/2020/05/EinScan-SE-Guidebook.pdf>

**4. Complete User manual**

<https://drive.google.com/file/d/1-mqS1klYj7G9rDnvoI4e8QsBGC5VvgWR/view>